WHAT IS CLAIMED IS:

1   1.   A method of canceling an interfering signal contained in a received signal

2   which includes a signal of interest, the interfering signal being a delayed and frequency

3   offset version of a transmitted signal from the location of the received signal, the method

4   comprising converting the received signal and a sample of the transmitted signal to digital

5   form; tracking variations in delay, frequency offset and frequency dependent gain and phase

6   variation between the interfering signal and the sample of the transmitted signal to produce a

7   compensating signal; combining the compensating signal and the received signal to cancel

8   the interfering signal and produce the signal of interest; generating an error signal from the

9   signal of interest representing any uncanceled components of the interfering signal in the

10   signal of interest; and controlling said tracking with the error signal to minimize offsets

11   between the compensating signal and the interfering signal.

1   2.   The method of claim 1 further comprising converting the signal of interest to

2   analog form for demodulating the signal of interest.

1   3.   The method of claim 2, wherein said converting comprises converting the

2   signal of interest to an IF signal.

1   4.   The method of claim 1, wherein said tracking comprises applying a variable

2   delay and frequency offset to the sample of the transmitted signal to compensate for initial

3   delay and frequency offsets and to produce an intermediate result; and adaptively filtering

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4   the intermediate result to track fine delay, amplitude and phase offsets to produce said

5   compensating signal.

1   5.   The method of claim 4, wherein said adaptively filtering comprises filtering

2   the intermediate result with a variable finite impulse response filter.

3   6.   The method of claim 5, wherein said controlling comprises controlling said

4   filter coefficients with said error signal to minimize said fine delay, amplitude and phase

5   offsets.

1   7.   The method of claim 6, wherein said filter has a plurality of tapped delay

2   stages, each stage having a tap weight, and said controlling comprises controlling the center

3   of mass by controlling the weight of each tap.

1   8.   The method of claim 7 further comprising deriving said error signal by

2   determining the power in samples of the signal of interest, using said error signal and an

3   existing adaptive filter weight update algorithm to control the filter tap weights so as to

4   minimize the power in the signal of interest.

1   9.   The method of claim 1, wherein said tracking comprises tracking the

2   frequency offset between the received signal and the adaptively filtered intermediate result,

3   and applying a frequency compensation to said sample of the transmitted signal after

4   compensation for initial delay.

1   10.   The method of claim 9, wherein said tracking and applying comprises

2   tracking the frequency offset and applying said frequency compensation using a phase

3   locked loop.

1   11.   The method of claim 4, wherein said applying a variable delay to the sample

2   of the transmitted signal comprises applying a delay offset with a delay memory, and

3   controlling said delay memory with said error signal so as to minimize the power in the

4   output signal of interest.

1   12.   The method of claim 1, wherein said converting comprises converting

2   separately the received signal and the sample of the transmitted signal from an IF to digital

3   signals, and down converting the separate digital signals to baseband.

1   13.   The method of claim 1, wherein said method of canceling is performed on

2   said digital signals at baseband.

1   14.   A method of canceling at a receiving site an interfering signal in a received

2   signal that contains the interfering signal and a signal of interest, the interfering signal

3   corresponding to a delayed and frequency offset version of a transmitted signal transmitted

4   from the site, the method comprising converting the received signal and a replica of the

5   transmitted signal from intermediate frequency form to baseband digital form; estimating

6   first offsets corresponding to coarse delay and frequency differences between the transmitted

7   signal and the interfering signal; applying first delay and frequency compensations

8   corresponding to the estimated offsets to the replica of the transmitted signal to produce a

9   first compensated replica of the transmitted signal; tracking variations in delay, frequency,

10   amplitude and phase offset between the first compensated replica and the interfering signal

11   to produce a second compensated signal; combining the second compensated signal and the

12   received signal to cancel at least in part the interfering signal and produce the signal of

13   interest; generating an error signal from the signal of interest; and controlling said tracking

14   with said error signal to minimize offsets between the second compensated signal and the

15   interfering signal.

1   15.   The method of claim 14 further comprising converting the signal of interest

2   to an IF signal, for demodulating said IF signal with a modem.

1   16.   The method of claim 14, wherein said estimating comprises cross correlating

2   the replica of the transmitted signal and the received signal to produce a result, and

3   determining the first delay and frequency compensations from said results.

1   17.   The method of claim 16, wherein said cross correlating comprises performing

2   cross correlations over a range of assumed delay and frequency offsets, collecting the results

3   from said cross correlations, and said determining comprises determining the first delay and

4   compensations from said collected results.

1   18.   The method of claim 17, wherein said determining comprises comparing said

2   collected results to a predetermined threshold value, selecting a peak, and determining said

3   compensations from delay and frequency offsets associated with said peak.

1   19.   The method of claim 16, wherein said cross correlating comprises Fourier

2   transforming the replica of the transmitted signal and the received signal to produce

3   respective sequences; shifting a first one of the sequences relative to a second one of the

4   sequences; forming a complex conjugate multiplication result of the first and shifted second

5   sequences; inverse Fourier transforming the result of said multiplication; and comparing the

6   Fourier transformed result to a predetermined threshold.

1   20.   The method of claim 16 further comprising determining a fine frequency

2   compensation for said replica of the transmitted signal by accumulating a plurality of cross

3   correlation results to produce an average result; comparing the average result to the

4   predetermined threshold to confirm said peak; Fourier transforming the accumulated results

5   which confirmed the peak to produce an array of magnitude values; and identifying the fine

6   frequency compensation from an offset associated with a maximum magnitude array value.

1   21.   The method of claim 14, wherein said tracking comprises applying to the

2   replica of the transmitted signal varying delay and frequency compensations in response to

3   the error signal to produce said first compensated replica signal; and adaptively filtering the

4   first compensated replica to track variations in delay, amplitude and phase and applying said

5   varying compensations to the replica to produce the second compensated signal.

1   22.   The method of claim 21, wherein said applying a variable delay

2   compensation comprises controlling a delay memory in response to the error signal to delay

3   the replica of the transmitted signal, and applying a variable frequency compensation

4   comprises adjusting the frequency of the delayed replica with a phase lock loop controlled

5   by the second compensated signal and the received signal.

1   23.   The method of claim 22 further comprising measuring the power in the signal

2   of interest to produce the error signal, and controlling said adaptive filtering and said

3   variable delay with said error signal to minimize the signal of interest power.

1   24.   An interference canceler for canceling an interfering signal corresponding to

2   a delayed and frequency shifted version of a transmitted signal from a received signal

3   containing the interfering signal and a signal of interest, comprising a variable delay for

4   applying a first delay compensation to a replica of the transmitted signal; a variable

5   frequency element for tracking changes in frequency and for applying a first frequency

6   compensation to the replica of the transmitted signal; an adaptive filter for tracking delay,

7   amplitude and phase variations in said replica following said first compensations for delay

8   and frequency to produce a cancellation signal; and a combiner for combining the received

9   signal and the cancellation signal to cancel the interfering signal and produce the signal of

10   interest.

1   25.   The canceller of claim 24, wherein the adaptive filter comprises a tapped

2   adaptive FIR filter having a plurality of fixed delay stages, each stage having a tapped

3   output and a corresponding weight element, and a summer for providing a combined output

4   of said tapped stages.

1   26.   The canceller of claim 25 further comprising a minimum output power

2   processor for determining the output power in the signal of interest and for generating an

3   error signal for controlling said adaptive filter and variable delay to minimize said signal of

4   interest power.

1   27.   The canceller of claim 26 further comprising an analog to digital converter

2   for converting said the received signal and the replica of the transmitted signal to digital

3   signals; a downconverter for downconverting the digital signals to separate digital baseband

4   signals corresponding to the replica of the transmitted signal and the received signal; said

5   variable delay, said variable frequency element, said adaptive filter and said combiner

6   operating on said digital baseband signals.

1   28.   The canceller of claim 27 further comprising a digital baseband processor,

2   said digital baseband processor comprising a microprocessor and associated control

3   programs for implementing said variable delay, said variable frequency element, said

4   adaptive filter and said combiner.

1   29.   The canceller of claim 28, wherein said minimum output power processor

2   and said least mean square element comprise control programs running in said

3   microprocessor.

1   30.   The canceller of claim 26, wherein said variable delay comprises a dual port

2   memory, a delay processor responsive to the error signal, and an address generator for

3   controlling the memory to minimize the delay offset in the replica signal, and wherein the

4   variable frequency element comprises a digital phase locked loop controlled by an output

5   from the adaptive filter.

1   31.   The canceller of claim 27 further comprising a digital baseband processor,

2   said digital baseband processor comprising dedicated electronics and associated control

3   programs for implementing said variable delay, said variable frequency element, said

4   adaptive filter and said combiner.